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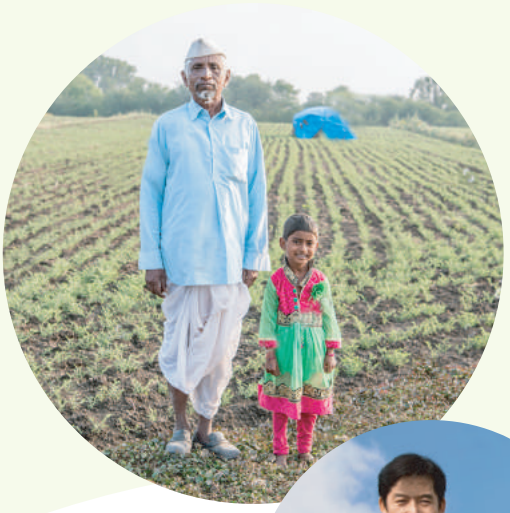
Economic Benefits of Glyphosate Based Herbicides



The global agriculture sector has transformed rapidly over the past 40 years.

Adoption of new farming practices and introduction of new inputs have increased yields and reduced soil loss, water usage, and greenhouse gas emissions. **Glyphosate based herbicides have made a positive contribution to both food security and environmental protection and have been proven to be safe for both the environment and human health when used according to the product label.**

Glyphosate based herbicides provide many economic benefits which include but are not limited to the following:

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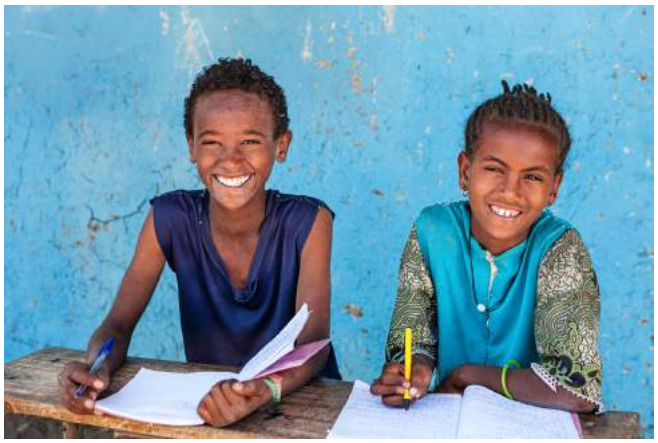
A Use of glyphosate based herbicides reduces the need for labor-intensive weed control



In many developing economies, farmers do not have the capacity for mechanized weed control and must manage weeds manually.

The availability of low-cost, labor-substituting technologies, such as glyphosate based herbicides, releases labor – typically women and youths – from weeding to focus more time on other economic opportunities and attending school.

B Use of glyphosate based herbicides reduces the need for conventional tilling

A major issue for farmers worldwide is how to prepare the soil for seeding by preventing weed competition. In the past, farmers with access to plowing equipment were very reliant on conventional tillage wherein the ground is tilled either after the previous crop or shortly before the next planting. Use of glyphosate based herbicides has allowed farmers to reduce their reliance on conventional tilling as a means of preventing weed competition. Now, many farmers kill or suppress emerged vegetation before or at planting time using glyphosate, which allows them to use more sustainable conservation tillage or no-till (direct seeding) systems. Reduced tillage also reduces the exposure of land to risk of soil loss through wind and water erosion, helps conserve moisture, and reduces the loss of soil organic matter.

C Use of glyphosate based herbicides can reduce pest pressure and improve crop quality and yield

The term 'green bridge' describes the role of weeds and crop volunteers in helping pests and diseases cross from one cropping season to another. A green bridge that allows a build-up of these pests and diseases prior to crop emergence can trigger disease and pest epidemics later in the season.

Use of glyphosate based herbicides at pre-emergence helps kill plants that provide this green bridge, thereby helping to minimize damage to the crop. Without competing weeds, crops can take advantage of additional space, light, water, and nutrients – leading to higher yields and higher quality products.

D Use of modern inputs such as glyphosate based herbicides is transforming low income economies

In Ethiopia, the average farm has decreased in size over the past decade to less than a hectare as the population and number of farmers has increased. Yet, even as average farm size decreased, Ethiopia has achieved relatively higher output per farm through the doubling of the use of improved seed and use of production tools like glyphosate based herbicide.

The rapid increase in use of glyphosate based herbicides has been driven in part by an increase in local rural wages and increased access to global markets. Overall, these changes are reported to have positively affected labor productivity, resulting in higher incomes for Ethiopian farmers.

E The loss of glyphosate based herbicides would cause serious economic harm to farmers and consumers

According to a 2017 study, the loss of glyphosate based herbicides would immediately reduce global farm incomes annually by USD$6.76 billion and reduce production levels of soybean, corn and canola by 18.6 MMT, 3.1 MMT and 1.44 MMT respectively.

The specific economic and agronomic impact of loss of glyphosate based herbicides on pulses industry has not been studied. However, it is reasonable to expect the loss of glyphosate based herbicides as an option would, as with grain crops, have significant impacts on global pulse production and farmer incomes – particularly in lower income countries dependent upon exports.

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Environmental Benefits of Glyphosate

A Glyphosate based herbicides have a shorter active life span and safer chemistry than many other herbicides

Glyphosate based herbicides, when used according to the product label, are safe for both the applicator and the environment. The median half-life of glyphosate based herbicides in soil has been widely studied. It has been reported that glyphosate based herbicides have a typical half-life of only 47 days in soil and are inactive to plant life once they bind to the soil.

B Glyphosate based herbicides use positively impacts soil and water quality

With conventional tillage, the process of tilling the soil speeds up the decomposition of crop residue and soil organic matter, and leads to increased soil erosion. Use of glyphosate based herbicides has led to more farmers adopting conservation or no-till practices that improve soil tilth and organic matter, which in turn traps soil moisture and helps prevents runoff into waterways and exposure of tilled soil to drying and wind erosion.

C Glyphosate based herbicides use helps reduce CO2 emissions

With conventional tillage, the process of tilling the soil leads to CO2 emissions. When farmers till less it not only reduces labor and saves time, but it also saves fuel and reduces CO2 emissions.

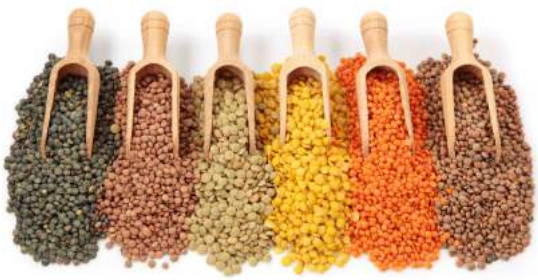
D Loss of glyphosate based herbicides would be harmful to the environment

If glyphosate based herbicides were removed as an option, farmers would return to farming practices that are more environmentally destructive. According to a 2017 study the loss of glyphosate based herbicides would increase the use of other herbicides by 8.2 million kg per year resulting in a large net negative environmental impact. In addition, a return to more conventional tillage would increase fuel usage and decrease soil carbon sequestration (increase carbon emissions) resulting in the equivalent of 11.77 million cars being added to the world's roads.

The same study also predicted that eliminating glyphosate based herbicides as an option would result in reduced yields and significant land use changes. It is estimated that an additional cropping area of 762,000 ha would be needed to offset yield losses, of which 53% would derive from new land brought into cropping agriculture, including 167,000 of deforested lands. These land use changes are predicted to induce the generation of an additional 234,000 million kg of carbon dioxide emissions.

Glyphosate based herbicides and Human Health

A Glyphosate based herbicides are approved for use in over 160 countries



Over 160 countries have approved use of glyphosate based herbicides. While glyphosate based herbicides are often associated with GM technology crops such as corn, soybeans and cotton, they are also commonly used for weed control with many non-GM crops such as tea, potatoes, sunflowers, oats and pulses.

B Glyphosate has more than 40-year history of safe use supported by more than 800 scientific studies and reviews

Glyphosate based herbicides are approved in over 160 countries precisely because they are one of the most extensively researched classes of crop protectant products in history.
Glyphosate based herbicides are considered to be environmentally and toxicologically safe, based on over 800 peer reviewed studies and environmental databases involving human health and/or crop residues.

C Numerous highly respected health and environmental agencies have concluded that glyphosate based herbicides are safe for use

The U.S. National Institutes of Health (NIH) , the Joint FAO/WHO Meeting on Pesticide Residues (JMPR) and the European Food Safety Authority (EFSA) have all reaffirmed glyphosate is safe for humans and does not cause cancer. The U.S. Environmental Protection Agency (EPA) and other regulatory authorities in Europe, Canada, Japan, Australia, Korea, and elsewhere routinely review all approved pesticide products and have consistently reaffirmed that glyphosate is safe for use.

In November 2015, the European Food Safety Authority (EFSA) concluded that glyphosate based herbicides are unlikely to pose a carcinogenic hazard to humans and the evidence does not support classification with regard to its carcinogenic potential.' In April 2015, the Canadian Pest Management Regulatory Agency also announced that 'the overall weight of evidence indicates that glyphosate based herbicides are unlikely to pose a human cancer risk.'

D When glyphosate based herbicides are used correctly residual traces pose no threat to human safety

Glyphosate based herbicides are safe to use because of their functional properties, which act uniquely on plants. Glyphosate works by inhibiting the shikimic acid pathway plants use to synthesize the amino acids phenylalanine, tyrosine and tryptophan. Glyphosate causes reductions in these amino acids, which are vital for plant protein synthesis and growth.

The shikimic acid pathway is present in the cells of plants and certain microorganisms but not in mammalian cells. The absence of this pathway in mammalian cells may explain why glyphosate based herbicides have low toxicity for humans. Evidence also shows the low toxicity stems from the fact that glyphosate does not accumulate in the human body but is instead excreted from the body almost entirely unmetabolized.

Increasingly, misinformation is being spread about pesticide residues, creating unwarranted confusion and concern among consumers. When it comes to pesticide residues, international regulatory authorities such as U.S. Environmental Protection Agency (EPA) and others have strict rules. In fact, the EPA sets daily exposure limits at least 100 times below levels shown to have no negative effect in safety studies.

E Measurement Values

Pesticide residues are normally measured in parts per million (ppm). Technology is now so advanced that residues can be detected in parts per billion (ppb). One ppb is equivalent to a drop of water in an Olympic-sized swimming pool or 3 seconds in a century. Therefore, it is important to understand that simply detecting the presence of pesticide residue does not mean there is cause for human health concern. The Codex Alimentarius Maximum Residue Limit for glyphosate in lentils is 5 ppm. The same value expressed in ppb would be 5000.

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Hazard Analysis Versus Risk Assessment

To make informed decisions about crop protectants such as glyphosate based herbicides and related MRLs for food it is essential to understand the **difference between hazard analysis and risk assessment.**

The key difference between hazard analysis and risk analysis is that risk analysis includes exposure or dose. Hazard analysis does not take into account the amount of exposure whereas a risk assessment, and the steps that are taken, minimize the potential hazard that exposure may create. For example, the hazard of a taking a drug is minimized by controlling the dose. The potential for skin cancer caused by sunlight is reduced by wearing hats, clothing, sun screen and staying out of the sun when radiation is at the highest levels. While many substances may potentially be a hazard for causing cancer over a life time of exposure (wood smoke, saw dust, aloe, sunlight, etc).) the risk is minimal when the exposure is limited. This same principal applies to personal care products, construction materials, home cleaning products and crop protection products. The registration process for use of chemicals in our homes, environment and foods considers the exposure to these products when they are used as a directed.

While a product may be listed as a potential hazard, without a discussion about the dose/exposure, it does not address the important consideration of risk.

Risk assessment studies consistently show that glyphosate based herbicides have very low acute toxicity, which means very high exposure is required to cause an adverse effect for humans. Further, since glyphosate is not stored in the body, any exposure from skin contact or inhalation would be quickly eliminated by humans and animals.

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Pulse Industry Use of Glyphosate

Glyphosate is a non-selective herbicide that is applied directly to plant foliage, which acts as a plant growth regulator.

Post-Harvest Application of Glyphosate

Glyphosate based herbicides are used after prior harvest to reduce competition from weeds for the next crop. Post-harvest herbicide application provides the next crop with improved access to light, water, and nutrients. Post- harvest application of glyphosate also kills green bridges, which helps reduce insect and disease pressure.

Pre-Harvest Application of Glyphosate

Pre-harvest glyphosate application is common in shorter growing season areas that generally have less time prior to killing frosts. Glyphosate based herbicides are particularly important harvest aids during overly wet or cool seasons. In Canada, Russia, Ukraine, Kazakhstan, U.S.A., and several north western European countries glyphosate based herbicides are commonly applied before crop harvest to kill green weeds and prevent weed seed contamination of the harvested crop. This pre-harvest application makes harvest more efficient and helps reduce crop losses.

Pre-harvest application not only kills weeds that are present in the crop, but also reduces weed growth in the following crop season. Glyphosate moves through the plant and will kill underground stems and roots that will regrow to create weed competition in subsequent crops. Pre-harvest applications of glyphosate are generally more effective in treating perennial weeds than applications made after harvest. Studies indicate that increased soil cultivation would be required for perennial weed control if pre-harvest applications of glyphosate based herbicides were not available.

The UK Home Grown Cereals Authority (HGCA) (2007) summarized the benefits as follows: "The pre-harvest application of glyphosate for the control of perennial weeds has brought tremendous benefits to the UK farmer. When compared to post-harvest application, it generally increases the control of perennial weeds and, in addition, its time of application does not result in a delay in cultivation after harvest. Indeed, it can be argued that the pre-harvest application has resulted in an overall reduction in glyphosate usage for perennial weed control." and "…pre-harvest application for perennial weed control, has resulted in the potential to reduce significantly the energy involved in crop production and has improved soil management and flexibility in cropping."

Maximum Residue Levels for Pulses

A Maximum Residue Limit (MRL) is the highest level of pesticide that is expected to remain on crops when a pesticide is used according to legally enforced label directions. MRLs are neither a safety limit or a benchmark for human health. MRLs are a measure used to ensure pesticides have been properly used and are primarily used for trade purposes.

Glyphosate is applied according to label. When glyphosate is applied pre-harvest, it is applied at both the proper stage of plant maturity and the pre-harvest interval (number of days between application and crop harvest). MRLs and pesticide labels are approved and enforced by national governments. In Canada, for example, strict government regulation and good agricultural practices ensure that glyphosate residues for pulse crops are kept to a minimum by legal enforcement of labels on glyphosate based herbicides. The Canadian label for glyphosate requires application at proper plant maturity and requires a 7-day pre-harvest interval.

Actual MRLs for pulses differ by governing authority but are universally very low.

Glyphosate Maximum Residue Levels (Parts Per Million)				
	EU	**Canada**	**USA**	**CODEX**
Lentils	10	4	8	5
Dry Peas	10	5	8	5
Chickpeas	10	5	8	-
Beans	2	2	5	2

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Resource List

General Information

- http://npic.orst.edu/factsheets/archive/glyphotech.html
- https://www.canada.ca/en/health-canada/services/
- https://www.efsa.europa.eu/en/topics/topic/glyphosate
- https://www.bfr.bund.de/en/the_bfr_has_finalised_its_draft_report_for_the_re_evaluation_of_glyphosate-188632.html
- http://apvma.gov.au/node/13891
- http://www.fsc.go.jp/ikenbosyu/iken-kekka/kekka.data/no_glyphosate_280406.pdf
- http://www.who.int/foodsafety/jmprsummary2016.pdf?ua=1

Economic and Environmental Benefits of Glyphosate

- https://link.springer.com/article/10.1057/s41287-017-0076-5
- https://www.ncbi.nlm.nih.gov/pubmed/29035143
- https://www.agric.wa.gov.au/grains/control-green-bridge-pest-and-disease-management
- https://www.epa.gov/ingredients-used-pesticide-products/draft-human-health-and-ecological-risk-assessments-glyphosate
- https://www.scimex.org/newsfeed/glyphosate-can-be-ingested-by-eating-crops-grown-with-it
- http://www.usask.ca/toxicology/jgiesy/pdf/publications/JA-228.pdf
- https://www.cabi.org/cabebooks/ebook/20153121434
- https://www.ncbi.nlm.nih.gov/pubmed/28414252

Glyphosate and Human Health

- https://aghealth.nih.gov/about/
- https://www.efsa.europa.eu/en/efsajournal/pub/4302
- https://www.ncbi.nlm.nih.gov/pmc/articles/PMC5515989/
- https://www.ncbi.nlm.nih.gov/pubmed/29226121
- https://www.ncbi.nlm.nih.gov/pubmed/29136183
- https://echa.europa.eu/-/glyphosate-not-classified-as-a-carcinogen-by-echa
- https://www.epa.gov/ingredients-used-pesticide-products/
- http://toxedfoundation.org/hazard-vs-risk/
- https://www.ncbi.nlm.nih.gov/books/NBK218582/